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relations of sciences: if the field of objects is criss-crossed in different directions it can only be in the interest of different problems. Is it not time to discard the assumption that, given a field of phenomena, there are to be recited an invariable set of problems that *go with it?*

But the reviewer is guilty of some disproportion in giving so exclusive attention to the first principles of a work in which second principles and fine observation are the prime movers.

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*Orientation in the White Rat.* HARVEY CARR and JOHN B. WATSON. *Journal of Comparative Neurology and Psychology,* January, 1908. Pp. 27–44.

This study presents the results of experiments on the white rat under two sets of conditions. First, rats that had learned a labyrinth path were started at one of three different positions fairly well along in the course of the maze, and were sometimes headed in the right, sometimes in the wrong direction; the object being to study their methods of correcting their orientation and picking up the right path. Secondly, again after the animals had learned the path, "certain of the runways were either shortened or lengthened. The disturbing effect of these alterations upon the rats' conduct and their methods of learning to adjust themselves to the new conditions were observed."

1. In answering the question as to how a rat set down with the wrong orientation can correct it and take up the labyrinth habit at a point other than the starting-point, the authors make two assumptions: on the one hand, that kinesthetic data alone may suffice to orient a rat, and, on the other hand, that if the animal does orient himself by kinesthetic data, he will require a period of random wandering about before the proper cue is obtained, longer than would be necessary if orientation were secured by some "distance sense." The first assumption is based upon Dr. Watson's former experiments on the white rat, in which it was shown that individuals deprived of sight and smell could learn a maze as well as normal individuals. Just here, without questioning the main point at issue, a word of comment may be interpolated. The argument from defective to normal rats is based, the writers say, upon the supposition "that the processes employed as control by the defective rats are the same as those which would have been employed by them had they been normal." This supposition seems to the present reviewer to be an unsafe one. What the performances of the defective rats show is that normal rats probably *can* learn a labyrinth by kinesthetic cues alone; it does not show that they *do* depend wholly upon such cues. However, in the present research the authors need to show merely the possibility of kinesthetic guidance. The second assumption, that orientation only after a period of random running about will indicate the use of kinesthetic cues, though recognized by the writers as not absolutely self-evident, may pass as probable.

The results showed that orientation was not immediate, but that "on the average, the rats turned around 2.5 corners in each trial before being able to pick up the cue," and that "inside the alleys, they changed the direction of exploration 1.3 times per trial." There were, indeed, a few cases of immediate orientation, the greater number having been made by two out of the eight individuals tested, and during the last half of the experiments. It is concluded that most of the cases of orientation were probably through the use of kinesthetic cues, that two of the animals may have used distance cues, and that there was some evidence that immediate orientation might be acquired by repeated experience of the situation. It is a puzzling problem that is presented by this process of *learning* to make immediate orientations. If a rat, on being put down at a certain point in the maze with his head the wrong way, immediately turns and starts out in the right direction, can it be a kinesthetic cue that makes him turn? How can he get a kinesthetic cue before he has made any movements? We should have been glad to have the inner aspect of this learning more fully discussed. Two of the eight animals, by the way, were blind, and showed no difference in their behavior on that account.

2. When, by the removal of the middle section of the maze, four of the alleys were shortened without in any other way affecting the path, rats that had learned the labyrinth in its previous state were much disturbed in traversing it. They ran headlong into the wall at the turns in the shortened passages, and on later trials made errors, hesitated, and attempted as a "compensatory adjustment" to make the turn too soon. After they had fully learned the shortened maze, the missing section was replaced, and the rats then tried to make the turns in the lengthened alleys at the point where they had turned in the shortened path.

The general conclusion drawn by the authors from their experiments is as follows: "When an automatic series of movements in man is disturbed, the 'movement to come' can no longer be released by the afferent impulses arising from the movement just effected. Visual, auditory, or tactual impulses (cues) are then utilized, *i. e.*, the adjustment becomes, *e. g.*, momentarily visual-motor. A few movements made in response to these distance sense cues may suffice to restore the kinesthetic-motor character of all the ensuing adjustments. Likewise, when an automatic series of acts in the rat is disturbed, the 'movement to come' can no longer be released by impulses arising from the movement just preceding. But at this point the analogy between the behavior of rat and man breaks down. The former apparently has no well-developed distance sense cues," but "the rat has the possibility of receiving kinesthetic cues which function for 'control' exactly as do visual cues in man." These kinesthetic cues the rat receives "by traversing at random any 'unit' of the maze." "On this supposition, man's kinesthetic-motor habits would differ from the rat's mainly in this, that whereas the former utilizes distance sense cues for reestablishing automatic adjustments, the latter utilizes kinesthetic cues."

These experiments certainly furnish interesting evidence of the function of kinesthetic factors in the rat's behavior. But it seems to the present reviewer that the authors' conclusion rather overemphasizes the difference between man and the rat in the matter under consideration. On the one hand, they report an observation that leaves open the possibility of the rats' having at a certain point been influenced by a visual cue. This observation was as follows: In the shortened maze, the six normal rats had no difficulty with one of the turns, while the blind rat "found as much difficulty with this corner as with any of the others." Now before reaching this particular turn, the rats had to pass a certain *cul-de-sac* opening, *B*. Could the normal rats have used this opening as a visual cue warning them of their approach to the turn, a cue which the blind rat must, of course, have lacked? There was another turn which was preceded, so to speak, by a *cul-de-sac* opening, *H*, and with this turn the normal rats did have trouble, but the writers point out that the *cul-de-sac* in this latter case had been open for some time, while the one in the former case had been recently opened. "One may argue that the normal rats had neglected the opening *H* as a visual cue in the course of the long series of trials which was given them in the learning maze from the first, while the recent opening of *B* had attracted their 'visual attention,' and they had learned to utilize it as a visual cue." While admitting the possibility of this, the writers think it improbable, for "if the rats can see the opening *B* so as to react to it, it seems that they ought to be able to see the opening into any alley at the turn and use it as a visual cue." But is it not at least conceivable that a visual cue which is given *before* a turn is reached can be more readily utilized by so rapidly moving an animal as the rat, than one which is given only at the instant when the turn must be made?

On the other hand, does a human being regularly use distance sense cues rather than kinesthetic cues in taking up an interrupted series of movements? The reviewer, from experience in playing the piano from memory, has no hesitation in saying that a breakdown in the series of movements can be repaired much better by kinesthetic cues than by distance cues. If the movements have been once really learned, that is, if one movement has come to set off the next directly, the best way of putting oneself right after a mistake is not to look at the hands, but to start at an earlier point in the series and run through the movements again, looking away or closing the eyes. In other words, the behavior of the human being best known to the reviewer is precisely like the rat's in securing orientation. And if a human being traversing a labyrinth and missing the path would be more likely than a rat to seek for a distance cue, is not this because movements of traversing a labyrinth would in a human being be too slowly made ever to become perfectly automatic? Any series of movements performed as rapidly by a human being as those of scampering through a maze are by a rat—for example, the movements in an intricate dancing step—would be most readily corrected by the use of kinesthetic rather than distance cues.

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